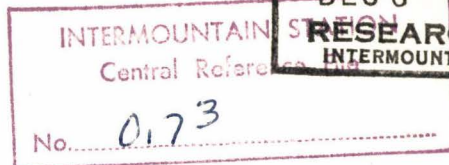
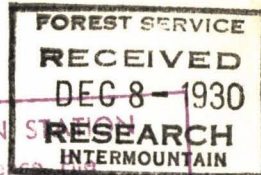


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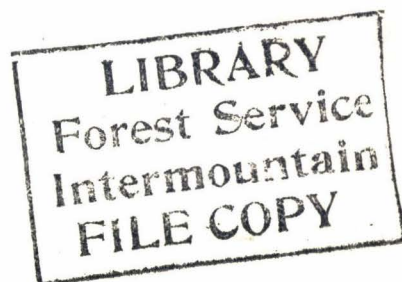
U. S. DEPARTMENT OF AGRICULTURE



REPORT OF THE

ALLEGHENY FOREST EXPERIMENT STATION

1929-30



UNIVERSITY OF PENNSYLVANIA

PHILADELPHIA, PA.

October 1, 1930.

Allegheny Forest Experiment Station

REPORT FOR THE PERIOD FROM APRIL 1, 1929 to MAY 1, 1930

by R. D. Forbes, Director

Inasmuch as the Station report for 1928 included a brief history of the Experiment Station, and a description of its plan of organization, no reference will be made to these subjects in this report. Last year's report also gave in some detail the economic facts upon which the program of the Experiment Station is necessarily predicated.

ADMINISTRATION

Advisory Council

On September 16 the Advisory Council held a field meeting at Camp Ockanickon, the headquarters forest of the Experiment Station, after enjoying the hospitality of Mr. Leeds of the Council, both at his farm in Woodbury, New Jersey, and at an inn in Lumberton, N. J. At the camp they were shown several of the experimental plots and were told of the investigations being made into the effect of rodents and perhaps other animals on the survival of seedlings of the south Jersey oaks. Dr. Carl Hartley of the Bureau of Plant Industry spoke briefly on roots and mycorrhiza of forest trees.

Contacts with other Agencies

The Station's contact with the University of Pennsylvania, by whose generosity the Station maintains comfortable quarters in West Philadelphia, has been extremely helpful. For example, the appointment of Dr. H. H. York as professor of plant pathology is a great stimulus, because of Dr. York's long connection with the Conservation Commission of New York and his outstanding work with the diseases of forest trees. Dr. York comes to Philadelphia at a time when the Station is preparing to associate with its staff representatives of the Office of Forest Pathology, Bureau of Plant Industry, and our relations with him should therefore be particularly close.

Helpful contacts have been formed or developed during the year with a number of other scientific agencies. Thanks to Dr. Lipman, the Director of the Station is now included in the group of Directors of Northeastern Agricultural Experiment Stations, who meet once or twice a year to discuss problems of mutual interest. The Director has served as chairman of a committee on types of the Allegheny Section of the Society of American Foresters, and has also been appointed to a committee of the parent Society which is considering a scheme of forest types for the entire United States. During the past summer the District Foresters of Northern Pennsylvania have aided the Allegheny Station by orienting its staff on the particular problems of their districts, and the forest types to be found there.

It is with great satisfaction that the Station learns of the establishment of a forest research institute within the Pennsylvania Department of Forests and Waters. The new institute at Mont Alto is a formal organization to take over and enlarge the program of research long carried on by the Department. Its founding is almost the first recognition by a State that forest research is a very large and

relatively unoccupied field, and that the more agencies there are at work in it the more swiftly may America progress toward real forest management.

Branch Stations

Development of the headquarters forest of the Experiment Station at Camp Ockanickon, a tract of 340 acres within an hour's drive of the Station's office in Philadelphia, has continued. Practically all of the organization work prerequisite to the undertaking of research at that point has been completed. We now have satisfactory maps of both interior and exterior boundaries; of the forest types; of the soils; and of simple management units. The inventory is also complete, so far as field work is concerned, and considerable growth data for individual trees have been collected.

It has been possible to obtain the services of a local weather observer at the Camp, so that we have recently installed a full battery of weather instruments, in the woods near the field house. This consists of a rain gauge, atmometers, soil and air thermometers, and anemometer, and a recording hygro-thermograph. Although there are official Weather Bureau stations in the vicinity of Camp Ockanickon, none of them is located in the woods. To use the records of town or city stations when describing conditions in the woods has been found not only unsatisfactory but positively misleading. A continuous record of the weather conditions within the Camp Ockanickon tract will prove invaluable in the development of experimentation at that point.

Selection has been made of a tract of land for a second branch station, on the Allegheny National Forest not far from the City of Kane. With the assistance of the Supervisor of the Forest a tract of about 1850 acres has been selected which from the point of view of accessibility and character of timber is admirably adapted to the Station's use. The bulk of the acreage contains chemical wood and even a considerable quantity of sawlogs. There is also a small area of thoroughly wrecked cut-over land - cut over and severely burned - which presents a problem in rehabilitation similar to that of large areas on the southern end of this National Forest. A particularly valuable portion of the area is about 100 acres of practically virgin hardwood, timber; no cuttings will be made in this tract, which will be preserved as an invaluable laboratory for the study of natural succession. The experimental area is traversed by a dirt road over which the great pulpwood-consuming town of Johnsonburg is not more than 15 miles distant, the last 7 miles over a concrete highway. There are also chemical-wood and tanning plants in the vicinity, and there should be a ready sale of sawlogs to the mills at Sheffield and at other points. Final arrangements for the use of this area for research purposes are now being made with the Forest Supervisor. Unfortunately neither the Heart's Content tract nor the permanent sample plots on Little Arnot Creek are in the vicinity of the experimental forest at Kane, but so far as possible no plots will henceforth be located on the Allegheny Forest except in the Kane experimental area.

The Station is slowly gathering together the necessary data for a wise choice of other branch stations. During the year the advantages of the Stokes State Forest in northern New Jersey were fairly well explored and compared with opportunities nearby. The New Jersey Department of Conservation and Development has given the Experiment Station a very cordial invitation to use a portion of this area for experimental purposes. However, to designate any area formally as a branch station, in advance of the opportunity to do intensive investigative work at that point, is in

our judgment unwise. Markets for forest products are not yet as good here as on the Allegheny National Forest, nor is there as much well-developed timber. During the year two tracts of forested land in government ownership have been brought to our attention, and present some possibilities as branch stations; these are the farm maintained by the Bureau of Animal Industry at Beltsville, Md., just within the Coastal Plain, not far from the City of Washington and a tract controlled by the United States Bureau of Mines in the bituminous coal region of western Pennsylvania.

Prospective Cooperation with the Bureau of Plant Industry

Unless the unexpected happens, a Federal appropriation of \$10,000 for the establishment of two pathologists at Philadelphia on July 1 appears to be assured the Office of Forest Pathology, Bureau of Plant Industry. The strength of the botany department of the University of Pennsylvania has been a strong inducement for their assignment to the Allegheny Station. These men will work on a program designated by their own bureau, but in unusually close contact with the Forest Service personnel. One of the two men, it is understood, will be asked to study the general problems of forest pathology in the Allegheny territory, with special emphasis on certain root rots and on diseases of nursery stock. The second man will undertake, in collaboration with a member of the Forest Service, a study of the mycorrhiza of forest trees. That the great majority of American trees, if not of forest plants generally, have certain fungi associated with their roots, has long been known; but, in spite of past studies made by a large number of individuals working independently, little really fundamental is yet known about the relationship of the host and the fungus. Obviously anything which affects the roots of growing plants affects their very life. It is entirely probable that many puzzling questions relating to the productivity of forest soils may be answered when we know more about mycorrhiza. For this reason an adequate study of mycorrhiza promises much for the future of American forests. The collaborator in this study from the Forest Service, Mr. Hatch, is now on educational furlough in Sweden, studying under an eminent authority on the mycorrhiza of forest trees.

Current ~~Correct~~ Research

In last year's report it was stated that the research program of a regional forest experiment station must be based on certain broad considerations. It cannot be based on the personal predilection of the station investigators for particular lines of work. Of the many important and fascinating problems which arise in every region, it is necessary for each station to pick out those which are intrinsically important, regional in scope, and reasonably well coordinated with the work of other research agencies. Four lines of work which in the Council's judgment met all of these requirements were described in last year's report. In this year's it has been necessary to subdivide one of these projects, and to add another, making the number now six. These are as follows: those of major importance being named first:

1. Natural reproduction and methods of cutting, Allegheny hardwoods

This title no longer covers the work in white pine. The data of 1928 from stands of pine, now analysed, has made the Station fairly certain that pine did not occur originally in the northern hardwood type, that is, in mixtures chiefly com-

posed of sugar maple, yellow birch, and beech. Its most frequent associates in north western Pennsylvania were red maple, black birch, and particularly the oaks and chestnut. For this reason those phases of the study of the type which deal with pine will be described under a later heading.

Work on the methods-of-cutting plots in Little Arnot Creek was continued, and practically all that on establishment was completed. Cutting was finished on Plot 4, so that today the plots represent a stand of northern hardwoods cut clear for sawlogs and chemical wood; an area in which sawlogs only have been removed; one in which both sawlogs and chemical wood have been taken out on a section basis, that is, leaving some of the best of the smaller trees for a second cut within 25 years; and finally a stand untouched except for the removal of half-a-dozen hemlock to the acre. In the course of this long job a number of methods of studying the small seedlings which come in following cutting have been devised and given a trial. No important results can be expected from these plots until a few years have elapsed. In the meantime, however, full use has been made of the data obtained in their establishment. For example, study of them shows that it is probably unnecessary to measure the height of trees of all species in a mixture such as this. Normally in a stand where there is a variety of species it is necessary to measure the heights of a dozen trees of well-assorted diameters, for each species, in order to establish a satisfactory relationship of height to diameter. If there are 10 or 12 species this of course makes the process of height measurement a laborous one. A study of the curve of height over diameter obtained at Little Arnot leads us to the tentative conclusion that but two curves are all that is necessary: one for the more tolerant species, such as the maples, the birches, and beech, the other for the less tolerant species, such as ash, black cherry, and basswood.

The main emphasis during the past field season has been placed on extensive surveys in the northern hardwoods type. With the help of a type map prepared by the Pennsylvania Department of Forests and Waters, and with the generous aid of several District Foresters in northern Pennsylvania, crews from the Experiment Station toured the greater part of the northern hardwood forest during the past summer. The method generally employed in the 1929 extensive surveys was to run a compass line through what appeared to be representative areas, recently cut over, of the types to be studied, and for half a chain on each side of the line to tally stumps and any standing trees; also to count on a 10-link strip along the compass line the dominants in the new generation of seedlings and saplings. The most satisfactory areas in which to make studies of this kind appear to be those which have been cut within the last 10 years. Here the stumps of the former stand have not ordinarily decayed to a point where they are unrecognizable or can not be measured with accuracy, and the young growth has reached a stage of development in which the final composition is pretty well established. From this double tally it is possible to say what the stand was before cutting, and what it is likely to be in the future. If a fairly accurate record of such disturbing influences as fire can be reconstructed, this method of study gives an idea of what the common methods of logging, coupled with forest fires, are doing to the composition of the hardwood forest. An occasional stand which had not been recently cut was examined.

During 1929 over eleven miles of compass line were run to obtain 177 half-acre

samples of forest, in all stages from virgin timber to recent cuttings. Since the areas sampled were pretty well scattered through north central Pennsylvania, and no particular choice was made of those to be examined, it is reasonable to suppose that the summer's work has given us a fair cross-section of conditions in the type as represented in the Station territory. An analysis of the figures on composition should at least prove ^{helpful} ~~helpful~~ in planning future work in the type; without such knowledge it would be nearly impossible to be sure that any sample plot, for example, was representative of a common condition within the type. Although this analysis has not yet been completed, it has already revealed that the northern hardwood type is an extremely variable mixture of species. The greater part of the type in the State of Pennsylvania has been cut clean for chemical wood, a product which utilizes limbwood and even saplings down to a few inches in diameter. A few acres of forest which had been selectively cut were, however, found for study. Provided the effect of cutting has not been obscured by fire, it ought to be possible to establish definitely from the data already obtained whether, as we now suspect, clear cutting increases the number of species in the next crop more than does selective cutting. Certainly the general tendency of clear cutting to encourage such worthless species as fire cherry and aspen, even in the absence of fire, is very evident. It is hoped that sufficient information has been obtained to permit us to prepare for publication a preliminary statement on the composition of the northern hardwoods type as it occurs in northern Pennsylvania, with some comment on the effect of different methods of cutting upon this composition. Anything final will require more field data.

Among the areas in this type which have been examined are some which have been reduced to an extremely unproductive condition by repeated fires following early logging. A critical comparison of areas burned a varying number of years ago may determine how long it takes to reestablish a forest of useful species on this type of land. The areas on the Allegheny National Forest studied in the 1929 extensive surveys had been designated by the administrative men as "unplantable", because of the presence of a large amount of brush. If they cannot be rehabilitated by artificial forestation, how many years of natural evolution is needed to restore them to anything like a productive condition becomes a matter of prime importance.

In the course of the summer's field work a number of miscellaneous matters apart from the main objects of the investigation seemed worth inquiring into, among them the relative sprouting capacity of the various northern hardwood species. Observation of 600 stumps of different sizes, are summarized in the following table. Perhaps the most interesting finding here shown, and supported by casual observation throughout the 1929 surveys, is that in this portion of its range yellow birch is an extremely poor sprout species; the literature indicates that elsewhere its sprouting capacity is high.

2. Natural reproduction, South Jersey

The inventory of the existing stand on the Camp Ockanickon tract revealed that at least 95 per cent of all the hardwood growth is of sprout origin. Examination of increment cores taken from chestnut oak trees shows that a decided falling off in height growth of this important sprout species occurs at about 25 years. If, as we suspect, such a falling off can be established as a characteristic of sprout in contrast with seedling stands, it is evident that seedling growth should be introduced as rapidly and in as great numbers as possible. Investigations of the natural reproduction of the chestnut oak are now under way at Camp Ockanickon, and the study

Sprouting Capacity - Northern Hardwoods

Diameter inches	Sugar maple			Beech			Yellow birch			Red maple			Black cherry		
	Sprouting	Stumps not sprouting	Percentage sprouting	Sprouting	Stumps not sprouting	Percentage sprouting	Sprouting	Stumps not sprouting	Percentage sprouting	Sprouting	Stumps not sprouting	Percentage sprouting	Sprouting	Stumps not sprouting	Percentage sprouting
	No.	No.		No.	No.		No.	No.		No.	No.		No.	No.	
1	191	0	100	11	0	100	0	3	0	11		100	4		100
2	84	0	100	6	2	75	0	1	0	12		100	2		100
4	42	1	98	5	11	31	0	12	0	16		100	9		100
6	12	2	86	4	3	57	0	7	0	5		100	3	1	75
8	8	0	100	7	4	64	0	6	0	2		100	4	1	80
10	2	2	50	2	6	25	0	3	0				1		100
12	2	0	100	13	2	87	0	1	0	0	1	0	2	2	50
14	1	1	50	5	4	56									
16	0	1	0	7	6	54							1		100
18	0	2	0	1	4	20							1		100
20	-	-	-	1	2	33									
22	0	1	0	0	1	0							1	1	50
24	-	-	-	-	-	-									
26	0	1	0	0	1	0									
28	1	1	50												
30															
32															
34														1	0
	343	12	96.6	62	46	57.4	0	33	0	46	1	97.8	28	6	82.4

will be extended to the other common coastal plain species as rapidly as possible. This study has two main phases; first, the study of seed production proper; and second, the study of the conditions under which seed germinates and seedlings become established.

In contrast with the fall of 1928, the past autumn has seen a relatively small crop of acorns in south Jersey. With one exception the 60 chestnut oak trees which were placed under observation for the first time two years ago failed to bear an appreciable number of acorns in 1929. However, collection of about a bushel of acorns from scattered producers made it possible to follow up earlier observations on the large part which rodents appear to play in the destruction of acorns. Wooden frames, 3 x 6 feet in size, covered with small-sized chicken wire, were sunk to an average depth of 4 inches beneath the crowns of certain chestnut oaks which will be latter intensively studied for acorn production. A seed bed had been earlier prepared by mowing the blueberry and other brush, and by raking and burning the debris. Three sets of acorns, 78 in number, were planted in various manners outside of these screened boxes; within three days all but two of the planted acorns had been removed by rodents, presumably grey squirrels. In no instance did there seem to be any shells or partially eaten acorns on the ground; the acorns had been carried off bodily. It is only natural to expect that in a lean seed year the few acorns which are available should be very completely cleaned up by the rodent population. Some evidence has also been gathered that the rodents' attack by no means ends with the destruction of acorns. A number of fully germinated seedlings had had the cotyledons eaten off, or were otherwise fatally injured, by animals or birds.

In view of the possibility that adverse weather causes failure of pollination and is responsible for the dearth of acorns, some chestnut oak flowers were artificially pollinized in the spring of 1929. Because the majority of oaks in south Jersey do not appear to bear flowers until at least 40 years of age, mechanical obstacles to work of this kind have been formidable. Facing an almost total lack of printed literature on pollination of forest trees the investigator has been obliged to devise most of his methods by trial and error. Ingenuity and persistence, however, finally resulted in hand-pollination of 84 flowers on a single chestnut oak, and the placing under observation of 89 flowers, not artificially pollinated, on an adjacent branch of the same tree. A week after pollination practically identical numbers - 43 and 44 - on both branches appeared to be developing into acorns; by autumn not a single artificially pollinated flower had matured an acorn, and of the 89 flowers not artificially pollinated, only one. The evidence is of course meagre, but in the face of this experiment it is hard to believe that the failure of the 1929 crop was due to lack of pollination. However, weather conditions from one season to the next may differ greatly, and the experiment will therefore be repeated this year with chestnut oak, and possibly with other species also. In spite of the well-known prodigality of nature in her efforts to reproduce all kinds of living things, it is rather staggering to consider that out of 173 flowers in this particular experiment, only one succeeded in maturing an acorn, and from the 176 acorns, the early history of which was given in last year's report, but three seedlings were produced and survived beyond a year.

A number of experiments planned to determine the seed bed conditions under

which acorns germinate have been made in the seven rodent-proof screens previously described. To determine the effect of planting the acorn radicle up or radicle down, about 40 acorns were placed each way in dibble holes 3 inches deep. In another experiment the same number of acorns were planted in holes only 1/2 inch in depth, and a mulch of one to three inches of leaves were thrown over the bed. Other acorns were simply left on the surface of the ground, from which the leaves of the current year had been removed. This sowing was compared with another in which the acorns after placement on the surface of the ground were covered with a layer of leaves.

In the course of the acorn collection it was noted that acorns from different trees, often adjacent individuals of apparently the same vigor, differed very widely in size and weight. Their germination, and the vigor of the seedlings obtained from them, is being compared from two batches of acorns, one averaging 9.25 grams in weight, and the other only 3.5 grams.

3. Volume and yield, eastern oaks

Our main contribution to this project, which is being conducted jointly by three or four of the eastern Federal experiment stations, has been the virtual completion of two studies of the number of cubic feet of solid wood contained in a cord of stacked wood. Although cubic feet of solid wood is the accepted unit in measuring tree or stand volumes in scientific work, the cord is still the commercial measure for pulpwood, chemical wood, and fuelwood. For practical purposes it is highly desirable to obtain a converting factor from solid cubical contents to stacked cords. A large number of variables are involved. It is by no means certain that the main variable is that which foresters have hitherto supposed to affect the converting factors most strongly; namely, the size of the sticks in the pile. It is entirely possible that the wood cutter could rick up the same wood twice and obtain stacks differing in size by a considerable percentage. It is also possible that different men working with the same wood would produce stacks of different sizes. Crook, or other physical characteristics of the material itself, are other variables hard to evaluate. In the past the factor of variation in size of stick has been studied by segregating material of like size. That is, on a cordwood-cutting job all of the 6-inch sticks or trees would be stacked together in a single pile, all of the 7-inch in another pile, and so on. Under these conditions the solid content of a stacked cord has been found to increase with the size of the stick and tree, although theoretically constant if the sticks are perfect cylinders. But since under ordinary working conditions material of different sizes is never so segregated, it is very doubtful whether converting factors obtained by this method are of any practical value. Therefore the plan followed in both the studies of converting factors which the Experiment Station has undertaken - one of about 50 cords of northern hardwoods, the other of 10 cords of oak - has been simply to measure the volume of each tree, from the dimensions of the sticks into which it was cut, and to see that no tree was divided between two or more stacks. Otherwise the woodcutters were left to work just as they would in actual practice. When the stacks were completed and measured it was possible to make up a series of equations showing that a certain volume of trees and sticks of one size, plus a certain volume of another size, and so on, equalled a stacked volume of so many cords. Each stack could be described by an equation containing as many unknowns as there were sizes of trees or sticks in it. This series of simultaneous equations would be very difficult to solve by simple algebraic methods. Normal equations were therefore obtained from them by the products-moment method

and solved by least squares. The job of computation has, however, been an extremely large one, as may be judged from the fact that in one study it was necessary to carry out some of the computations to 32 significant figures.

The converting factors finally obtained will show how many cubic feet of solid wood are contained in a stacked cord obtained from trees or sticks of specified diameters. Conversely, with their aid an estimate of tree or stand volume expressed in cubic feet may be converted into cords.

Accurate volumes of nearly 300 oaks of various species and sizes were obtained in the oak converting factor study. The work was done through the generous cooperation of Black Rock Forest, Cornwall-on-Hudson, New York, when oak cordwood operations proved difficult to find in the Allegheny territory proper. On another area encountered in the extensive surveys volumes were obtained for 86 trees of these and associated species. These measurements will permit comparisons of tree volumes obtained locally, where conditions may or may not be typical of the region at large, with the average volumes for the entire region contained in the volume tables now completed. These include tables for white, red, and chestnut oaks, chestnut, red gum, hickory, red maple, yellow poplar, and black cherry. Should local conditions result in an appreciably different form of the trees, so that regional volume tables will not apply it is very important to devise workable methods whereby local volume tables may be made from the more generalized tables. The former Associate State Forester of New Jersey, Mr. Baker, has compared the volumes of oak trees in New Jersey with the regional volumes of the new Federal tables. He finds no very substantial difference in the form of the trees between this one state and the oak region generally.

So far there has been no time in this study to prepare the figures on yield per acre of even-aged oak stands. All available help has been thrown into the very large job of computing tree volume tables. The Station's contribution to the yield study has been the establishment of 14 permanent sample plots in oak stands at Camp Ockanickon. Because normal yield tables are based on fully-stocked stands, and aim to represent the full growing capacity of the soil, rather than the volume of wood that happens to be present in a stand, as the result of past vicissitudes, yield table values will unquestionably be considerably higher than those generally attained in stands of average density for the region. It has been customary to think of understocked and overstocked stands of any species as gradually approaching, with the passage of time, a fully-stocked or ideally-stocked condition. To test this theory requires putting actual understocked or overstocked stands under observation for a long period of years. The tenth-acre plots at Camp Ockanickon represent understocked stands. Advantage has also been taken of the opportunity afforded by our "safety strips" to observe the effect on growth of removal of brush from oak stands. Office computations have not yet been computed for the plots.

Incidental to the laying out of the sample plots at Camp Ockanickon, a study was made of the methods of measuring the height of trees on permanent sample plots. Opinions among professional foresters differ widely as to the relative accuracy of various height-measuring devices, and of the effect of the personal factor in height measurement. Since such measurements at best consume a considerable amount of time on every project, it is highly important to determine at the earliest possible moment the method best suited to particular conditions. The Ockanickon study compared the accuracy of the Abney hand level and the Forest Service, Klausner, and

Faustman hypsometers, also the time required in their manipulation. The results of this study, when computed, should be a worthwhile contribution to the manual of field methods in silvical research work which is being prepared in the Branch at Washington.

The accidental location of an oak stand near Okome, Pa., from which trees had been selectively logged 16 years ago, and was again being culled, suggested a brief study of the accelerated growth of released trees. A quarter-acre plot was laid out, and complete stem-analyses made of 14 felled oaks. Information was also obtained on the 19 trees left standing, and on the reproduction. The data from this study are not yet completely analyzed.

4. Forest types

In the absence of much direct knowledge of the types of our region, and in view of the diversity of type classifications which are used by the forestry organizations of our territory, the Station has hitherto followed a rather generalized scheme of forest types, based upon Merriam's life zones. Thanks to our participation in a committee on forest types, which was recently set up by the Allegheny Section of the Society of American Foresters, and also to our increasing familiarity with the region, it has been possible for the Station to abandon this rather unsatisfactory method of classification in favor of a plan tentatively set up by the Section committee. The committee's list of types is as follows:

- | | |
|--------------------------------|------------------------------------|
| 1. Spruce - Hemlock | 10. Red Cedar |
| 2. Spruce - Fir - Larch | 11. Virginia Pine |
| 3. Maple - Birch - Hemlock | 12. Gray Birch |
| 4. Aspen - Fire Cherry | 13. River Bottom - Swamp Hardwoods |
| 5. Yellow Poplar - Oak - Maple | 14. Southern White Cedar |
| 6. White Pine - Hemlock | 15. Loblolly Pine |
| 7. Oak - Hard Pine | 16. Pitch Pine |
| 8. Oak | 17. Cypress - Gum - Red Gum |
| 9. Scrub Oak | |

Neither the Section committee nor the Station has attempted to map these types in Pennsylvania, New Jersey, Delaware, and Maryland. The Pennsylvania Department of Forests & Waters has courteously furnished the Station with a good-sized map of the northern hardwoods (maple-birch-hemlock in the foregoing classification) based on detailed field work, but so far as we know the boundaries of no other type have been similarly drawn. Realizing the close correlations which often exist between climate and vegetation, the Station has endeavored to compile and place on regional maps all available data, as an aid to future type mapping. The difficulties of reconciling data from several states have been considerable, but with some aid from the local office of the U. S. Weather Bureau nine fairly satisfactory charts have been prepared for the region, as follows: average annual temperature; mean minimum, mean maximum, and average temperature, June to September inclusive; average date of last killing frost in spring, and of first killing frost in autumn; length of growing season; average annual precipitation; and average precipitation June to September inclusive. Already it has been possible to prepare from these maps and the Pennsylvania map already referred to the following description of the climate characterizing both the northern hardwoods type and the Allegheny region.

Climatic Factor	Peech - birch maple	Entire region
Average annual temperature	44° - 49° F	44° - 57° F
Average date of last killing frost in spring	4-20 to 6-10	4-10 to 6-10
Average date of first killing frost in fall	9-10 to 10-30	9-10 to 11-10
Average length of growing season, days	120 - 165 days	120 - 224 days
Average summer temperature (June-Sept. incl.)	63° - 68°F	63° - 75° F
Mean minimum summer temperature (June-Sept. incl.)	53° - 55°F	53° - 67°F
Mean maximum summer temperature (June-Sept. incl.)	74° - 79°F	74° - 85°F
Average annual precipitation	38" - 50"	34" - 50"
Mean summer precipitation (June-Sept. incl.)	14" - 19"	14" - 20"

Because under this classification white pine may no longer be included in the northern hardwood type, the work of the Experiment Station in the virgin white pine stand at Heart's Content in the Allegheny National Forest must be treated under the project of types, rather than under the project of natural reproduction of northern hardwoods. The Station's first important publication, a paper entitled "The Vegetation of Heart's Content, a Virgin Forest in Northwestern Pennsylvania", then becomes a progress report on type studies. This careful botanical and ecological description of the Heart's Content area, which appeared as the lead article in Ecology for January, 1930, establishes facts which may later be applied in experimental silviculture on adjacent land in the same type.

By all odds the most interesting finding at Heart's Content is that the white pine is practically even-aged, whereas the hemlock and perhaps other species in the mixture are all-aged. This at once suggests that some catastrophe, probably fire, was responsible for the establishment of the white pine over 250 years ago. Analysis of most of the extensive survey data obtained during the summer of 1928 now reveals that evenness of age has characterized many other white pine stands. A paper, now nearly complete, shows that all of the stands of young white pine which have so far been tallied are essentially even-aged, and that the distribution of the pine by diameter classes follows closely the law of normal frequency. That is, there are more trees in the average diameter class than there are in any other diameter class,

and the number of trees in the classes above and below fall off symmetrically on each side of the average. (In forest types where trees are of all ages from one to many years the distribution by diameter is very different; the smallest diameter class contains far more individuals than any other, and the number succeeding classes diminishes regularly.) If normal frequency in diameter distribution is characteristic of even-aged white pine stands, even in the virgin forest - and the one example yet studied of white pine in the virgin forest, Heart's Content, certainly confirms this idea - then it is significant to find that the diameters of white pine stumps representing other virgin stands likewise fall into the same symmetric distribution. Although the Experiment Station is not yet satisfied to make a positive statement at this time, all our evidence points to a catastrophic origin for the white pine in the virgin forests of north-western Pennsylvania. This means that the white pine type is not a permanent type, but is as temporary as Douglas fir in the Pacific Northwest, and western white pine in Idaho and Montana. If later data confirm this idea, we have a very useful hint to guide us in the future silviculture of this species.

From some points of view the current study of the northern hardwoods type, although the main emphasis has been placed on composition as affected by methods of cutting, may be regarded as a type study. Certainly should the evidence show that composition is little changed by different methods of cutting, all of the samples may be lumped together, and type characteristics obtained from them.

A study of succession of forest types in south Jersey as affected by soils was begun last spring, but was necessarily abandoned temporarily with the investigator's resignation. The investigation had gone no further than to establish tentatively the natural succession of types. From a general reconnaissance, and detailed study of 29 sample plots in well stocked stands, it appeared that on land cleared and cultivated and then reverting to forest the normal succession is from a pine association through pine-hardwoods to the climax, a better hardwoods-pine association (oak-pine). A less common succession is from mixed hardwoods (poor) to the climax. On cut-over land the normal succession is hardwoods (chiefly oaks) developing into a better hardwoods-pine climax; occasionally the development is through a pine or pine-hardwoods association to the climax. Certain inconsistencies in the data, such as higher basal areas in young stands than in old, and sometimes in temporary types than in the climax, suggests the need for considerably more data.

PROPOSED WORK

Partly because of resignations from its staff, and partly because of its assumption of at least joint responsibility for the loblolly pine yield study, the Station has fallen somewhat behind in its analysis of the field data already collected. Until the data already on hand have been "squeezed dry", it would be most unwise to collect any more in the field. With 2 exceptions the 1930 field and laboratory work will merely supplement the information already obtained on going projects.

CURRENT PROJECTS

Planting, South Jersey

It is planned to repeat the planting work at Camp Ockanickon, with much the same species, and on ground adjacent to this year's plantations. It is hoped that loblolly pine, unobtainable this year, will be available next year. It is planned to obtain seed of native species locally for production of stock to be used in future plantations.

This is a sub-division of the project previously described as "Management of Camp Ockanickon". The headquarters forest at Camp Ockanickon is typical of south Jersey, in that most of it is 40 to 60 per cent under-stocked, and shows little tendency to fill the gaps in the stand with seedling growth. Following the example of the New Jersey authorities, who have interplanted sprout oak stands with conifers on a large scale, the Station interplanted about 15 acres at Camp Ockanickon in March and April. A few less than 3850 seedlings of white, red, jack, pitch, and shortleaf pine from the New Jersey state nursery were planted on an area which had been cut over 8 years ago, and on which there was considerable sprout growth of oak. The general plan followed was to plant only those openings 36 square feet in extent or the space allotted each seedling in a plantation regularly spaced 6 by 6 feet. This resulted in planting between 125 and 550 conifers to the acre, and in a rather difficult technical problem of recording the survival of all of the scattered and irregularly spaced trees. Driving a numbered stake by every seedling in restricted areas seemed the only recourse.

Two of the species used - shortleaf and pitch pine - were natives of the region, and should do well. The other three species have been planted with a fair degree of success elsewhere in south Jersey, but no stand has as yet been brought to sawlog maturity. Mr. Lee's detailed soil map will permit comparisons of growth on various sites. A small portion of the planting site was cut clean of all hardwood brush, in order to simulate conditions in plantings made immediately following the cutting of a cordwood stand. The one fact that has yet developed from this plantation is that jack pine suffered a loss of over 37 per cent of the seedlings from rodents within a month after planting; an additional 12 per cent is badly damaged. This is in contrast with a damage of 5½ per cent or less for the other species. Just what the rodents are is not absolutely certain, but it is thought that they are rabbits, which at a time when other green vegetation is extremely scarce have been attracted by the new central shoots of the jack pine.

This year's plantation is only part of a program to be followed out in the succeeding six or eight years, with the same species and the same method of planting. Repetition of the experiment will not only enable us to discount the climatic factors which are of course extremely variable, but will also give us a sufficient area to allow of future experimentation in methods of handling well-stocked stands.

Growth and yield, loblolly pine

This project has been added to the program of the Experiment Station at the request of the Maryland authorities. In 1905 about 60 permanent sample plots were laid out in stands of loblolly pine of varying densities on the Eastern Shore of Maryland. The original object in their establishment was to determine yields, and the

rate at which stands of different densities approach normal stocking. All of the plots were laid out on private land, and many of them have since been cut over. Twenty four, however, still remain, having been remeasured at 5-year intervals by the Federal and State forest services in cooperation. The Station has just made the re-measurement at the end of the 25th growing season following the establishment of the plots. Some of the plots have been thinned at the time of previous remeasurements, so that this project is really a combined study of growth under natural conditions, and growth as influenced by thinnings. Computation of these data is going to be a rather laborious matter, and must await the completion of projects already underway. Although the project had not been approved as a part of the Station program, the field work was done because the State authorities of Maryland felt that remeasurements should be made at 5-year intervals.

Because of the large amount of office work involved in the study of the loblolly pine data from the Eastern Shore of Maryland, no additional field work in mensuration is proposed.

Natural reproduction and methods of cutting, Allegheny hardwoods

In the methods-of cutting study of the northern hardwoods, it was planned last summer to make an intensive examination of an area of virgin timber southwest of Wetmore, on the Allegheny National Forest. Unavoidably postponed, the examination will demand a major part of our attention in 1930. This tract of several hundred acres is undoubtedly the largest within the Allegheny territory which has not yet known an axe or saw. The Central Pennsylvania Lumber Company owns it, and in the past year constructed a logging railroad to reach it via the east branch of Tionesta Creek. As soon as the lumber market improves a little, the company will begin active lumbering operations, but will hardly finish the job in less than two or three years. In this time almost priceless information on the northern hardwood type can be obtained from the tract, which includes a diversity of topographic conditions, and some variations in its progress toward an ecological climax. Because the stand has not yet been cut the summer's work cannot be considered, strictly speaking, part of the methods-of-cutting study in this type, but may prove a highly desirable preliminary to such a study. The job will probably take a crew of three or four men at least six weeks. One of its most important features will be the selection of an area of possibly two or three hundred acres, which it will then be our endeavor to persuade the National Forest Reservation Commission to purchase and add to the Allegheny National Forest. It is of course not known whether the Central Pennsylvania Lumber Company will be willing to sell any of the virgin timber, but certainly the precedent established last year by the Reservation Commission in buying the 100 acres at Heart's Content as a natural laboratory should be taken advantage of, and every effort made to obtain the purchase of the Wetmore area for scientific research. Only in a forest which has suffered no human interference is it possible to discern and evaluate the natural forces which mold the composition and character of the forest, and which man cannot successfully defy for more than brief periods.

Natural reproduction, south Jersey

Plans for the natural reproduction study of coastal plain species at Camp Ockanickon embrace additional field work along the lines already followed, but with perhaps one more species. Since in this work we are largely feeling our way, devising our own methods of field work, nothing more specific can be stated.

Volume and yield, eastern oaks

The study of volume and yield of the eastern oaks is nearly completed, so far as this Station is concerned. The results of the converting factor studies should be published during the year. The preparation from existing tables of volume tables in terms of mineprop material, postponed from last year, now appears to be more of an office than a field job, although a little field work may have to be done. We already have the cooperation of the forester for the Anthracite Producers' Association, and believe that the project can be pushed rather rapidly.

Forest types

For a variety of reasons the study of the composition of the white pine type, which has already been begun, should be extended during the coming summer. It can hardly be doubted that the type has produced the largest yield of high grade material of any type in the four states. Our findings to date are entirely based on conditions in the extreme northwestern portion of Pennsylvania, near the edge of the white pine's range, and we do not feel at all confident that the same conditions existed at points more nearly within this range. It is proposed to follow the extensive survey method in studying second-growth stands of white pine, also stump areas representing virgin stands. The central portion of Pennsylvania, and if possible parts of northern New Jersey, will be sampled. Evidence concerning the original forest of this pine is rapidly passing away, and the sooner we can reconstruct past conditions the better guides we will have for the silvicultural management of white pine in the future.

The majority of forestry organizations today advise strongly against the use of white pine in pure plantations, and it may be of real value to the profession to know whether the original stands of white pine in the Allegheny territory tended to be even-aged and pure. If they were, it is important to know how extensive they were. Since the blister rust is already firmly established in Pennsylvania, and white pine can obviously not be used in areas where wild gooseberries and currants are not at all numerous, it goes without saying that every effort should be made to determine the extent of Ribes infestation of possible white pine sites. Should our findings warrant the belief that the use of white pine in artificial reforestation in the Allegheny territory is not as dangerous as has been previously thought, this work may very well lead to a study of the silvical characteristics of white pine. Such a study is not on the program of either of the Federal experiment stations adjoining the Allegheny on the north or the southwest, and so far as we know is not contemplated by any other research agency in our territory. A main advantage in pursuing work on the white pine type, is that it will carry members of the Station staff into portions of two States hitherto unfamiliar to them.

NEW PROJECTS

1. Fire damage

A new project on which some preliminary work will be done during the coming field season is a study of fire damage.

Ten possible fields of fire investigation were described in a memorandum sent to the Council last fall. No recommendations were made at that time as to which line of work the Station should undertake. That the fire problem is still an extremely urgent one is well demonstrated by events this spring in all four of our states. The great majority of the projects listed in the report to the committee were directly or indirectly concerned with the administrative jobs of fire prevention and fire fighting. It seems to us doubtful whether the Station can successfully undertake studies in administrative fields. An alysis of fire statistics, for example, requires an intimate knowledge of the conditions under which they were collected. There is much variation in the competence of individuals to report the necessary facts, and only the officers of the organization concerned are able to evaluate their fire reports, and draw really sound conclusions from data taken from them.

The State Forester of Maryland has suggested that possibly a newcomer might effectively undertake a study of the fire problems of a restricted area, such as the 125,000 acres on Catoctin Mountain, northwest of Frederick, Maryland. Here the fire situation has been exteremely serious. Although thoroughly comparable yearly records are perhaps not available for as long as ten years, about 40,000 acres on the mountain have burned over in that time. Undoubtedly a great deal of this acreage has burned twice, and forest growth on much of the mountain is in bad shape. The administrative men charged with the protection of this area have had a great many other duties on their hands besides an analytical study of the fire problems of this area. The suggestion was that an alert outsider with an open and inquiring mind might possibly see elements in the situation which the local men had not been able to see, either because of too great proximity to the problem or to lack of time for its consideration, and might evolve better methods of prevention and control. The very fact, however, that the Maryland foresters have already gone a long way in studying the problems of this area, is in our judgement the best proof that the job of analyzing a fire situation such as this should be carried out by administrative men. It would appear to us far sounder to encourage the State of Maryland to allow a qualified man from its own organization the time necessary really to get to the bottom of this problem, than for an outside agency such as the Federal experiment station to undertake the job.

The physical damage caused by fires to vegetation, soil, and recreational and watershed values is a subject on which there is the greatest need for information, and is at the same time a subject for study by the trained investigator. There is little concrete information available on what effect fires of different intensities, such as result from varying combinations of weather conditions, have on even a single tree species, and there is even less information concerning their effect on whole types. Yet the damage which fires may cause to the type should be an important factor in considering how great an expenditure per acre for protecting it is justified, and in planning the entire fire campaign in a state, national forest, or private holding.

In order to measure the damage caused by one or more fires, it is necessary to know intimately the composition, quality, and rate of growth of the forest both after burning and in an undamaged condition. Accurate appraisals are impossible without knowledge of site. Studies of composition, quality, (particularly as affected by decay) growth, and site require the undivided attention of men trained in research methods, and sooner or later, in the fundamental sciences.

It is the Station's opinion that its most effective contribution to fire protection will therefore be a thorough study of fire damage. It hopes to make a start during 1930 toward determining which of the several forest types in our territory are most in need of such a study, and what general methods should be followed in the work.

2. Mycorrhiza

The studies in forest pathology which are planned for the coming year, thru the cooperation of the Bureau of Plant Industry, can not be described at this time in any greater detail than was contained under the heading "Prospective Cooperation with the Bureau of Plant Industry", page, but will be very important additions to the Station program.

NEEDS

Emphasis was laid in last year's report on the desirability of having associated with the silviculturists at the Allegheny Station forest pathologists, entomologists, and zoologists. The prospect of having cooperation in the field of pathology after July 1 is extremely heartening. But the need is more than ever acute for specialists in entomology and zoology. For example, no study of white pine can ignore the weevil which has done untold damage in other portions of this tree's range. If it should prove true that white pine originally grew in even-aged, pure stands in the Allegheny territory, the habits of the white pine weevil here would appear to differ from its habits elsewhere. Otherwise it is hard to explain the admittedly high quality of the white pine which was produced in the virgin forests of Pennsylvania.

Again, the Station is as far as ever from real knowledge of how to cope with the destruction of acorns and probably other tree seed by birds and animals, in southern New Jersey, a destruction which is obviously helping to keep the forests in a low state of productivity. Should the attempt be made in the fire damage study to appraise the loss in recreational value thru injury to game, it will obviously be necessary to have the services of an expert zoologist.

Before committing itself to any considerable study of white pine, the station should know whether the production of softwoods in part of its territory is justified on economic grounds. The part referred to is the Allegheny Mountains and Plateau, where the soils are generally heavy enough to produce excellent hardwoods, and where of the two important softwoods hemlock appears handicapped by slow growth and white pine by susceptibility to insect and fungous attack. It may well be that "territorial division of labor" dictates the growing of hardwoods in the Alleghenies exclusively, leaving the production of softwoods to the Coastal Plain and other sandy provinces of this and adjacent territories. Assignment to the Allegheny Station of a forest economist to work on this and a dozen other important economic problems is very strongly recommended.

List of Articles Prepared for Publication

Published:

An Improved Method for Numbering Trees on Permanent Sample Plots. Berg. Journal of Forestry, Oct. 1929.

Technical Note #1, A. F. Hough, Stump Diameter - D.B.H. Relationship for Beech in Northwestern Pennsylvania. Mimeographed.

The Effect of Soil on Tree Form. Morey. Service Bulletin, Dec. 30, 1929

The Vegetation of Heart's Content, A Virgin Forest in Northwestern Pennsylvania. H. J. Lutz. January, 1930. Ecology.

Statistics That Are Different. Miss Skamser. Service Bulletin. November 16, 1929.

Using the Society Decimal Classification. Miss Skamser. Monthly Report October, 1929.

What Uncle Sam Does to Solve the Forest Problem. Forbes. Engineers and Engineering (Phila.) April, 1930.

Review of "The Forestry Question in Great Britain" (E. P. Stebbing). Lutz. Journal of Forestry, January, 1930.

Volume Tables for Second-Growth Black Cherry. Schnur. Alinement Chart.

Submitted:

Investigating a Neglected Crop. (for New Jersey Agriculture). Forbes.

Progress in the Research Reserve Program. Forbes. Journal of Forestry.

Tags and Painted Numbers of Trees in Permanent Sample Plots Morey. Journal of Forestry.

The National Forest Reservation Commission and Forest Research Reserves. Forbes. Science.

Review of Forestry and Coal Mining". (Clearfield Bituminous Coal Corporation). Forbes. Journal of Forestry.

EXPENDITURES, FISCAL YEAR 1930*

BY BUDGET ITEMS

Salaries permanent	\$20,613.00
" temporary	2,045.00
Travel (exclusive of auto mileage)	3,540.00
Travel (auto mileage)	700.00
Supplies and equipment	3,637.00
Rent, light, power and water.....	175.00
Freight, express, and drayage.....	100.00
Improvement	100.00
Miscellaneous	110.00
Contributed to other Forest Service units	<u>800.00</u>
	\$31,820.00

Projects BY PRODUCTS

Forestation	\$ 752.00
Management	18,856.00
Measurement	8,640.00
Protection	770.00
Types	<u>2,002.00</u>
	\$31,020.00
Contributed to other Forest Service units	<u>800.00</u>
	\$31,820.00

*Last two months estimated.

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C. P. Wilber, State Forester, Department of Conservation and Development, Trenton, New Jersey.

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